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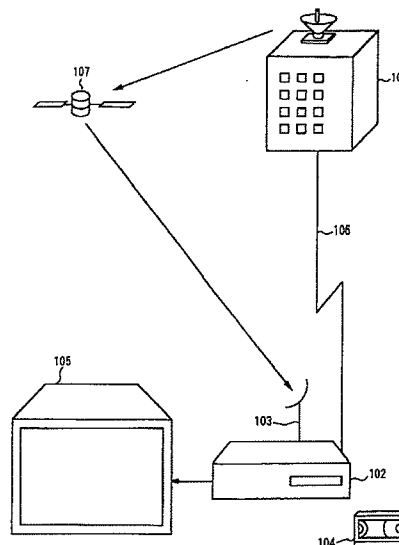
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(54) **Receiving controlled-access broadcast signals**

(57) An apparatus and method for transferring from
a broadcaster (101) to a receiver (102) a limited repro-
duction right in data. A signal indicating the limited
reproduction right is transmitted by the broadcaster
(101) and stored (104) by the receiver (102) with the
data. The receiver (102) reproduces and processes the
data as a function of this signal.

Fig. 1



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Description

[0001] This invention relates to data communication in which controlled-access broadcast signals are received, such that, for example, a limited reproduction right in video data is transferred between a broadcaster and a receiver.

[0002] Commonly, video programming is transmitted from a broadcaster to a user via a satellite or cable communications system. In some systems, users are able to request, and broadcasters provide, select video programming through the use of individually addressable decoding receivers. The user's decoder is activated upon receipt of the user's address which is transmitted along with the requested video programming.

[0003] The drawback of such system is that the user is often able to record the requested video programming for later reproduction. This later reproduction occurs without any royalty payment to the broadcaster or other holder of copyrights in the video programming. Further, the recorded video programming can be disseminated by the user to others for additional reproductions without corresponding royalty payments.

[0004] This application is a divisional from European patent application number 95304743.8, filed on 6 July 1995, and published under number 0 691 787.

[0005] In accordance with the present invention, an apparatus for receiving, recording, and reproducing data signals is provided. A receiver receives transmitted data signals along with an access-control signal, the latter serving to control subsequent processing of the received data signals. The processed data signals are recorded in a first storage medium, and the access-control signal is stored in a second storage medium. When the processed data signals subsequently are reproduced from the first storage medium the access-control signal is retrieved from the second storage medium, and is used to control the reprocessing of the reproduced data signals.

[0006] A preferred embodiment of the present invention provides a system for the transfer between a broadcaster and a user of a limited reproduction right in transmitted data.

[0007] The preferred embodiment enables a user to request from a broadcaster a particular limited reproduction right in a selected video program, while preventing the reproduction of transmitted data by the user without adequate payment for each reproduction.

[0008] Other aspects of the present invention are set out in claims 1, 17, 23, 27, 36, 39 and 40.

[0009] The invention will now be described by way of example with reference to the accompanying drawings, throughout which like parts are referred to by like references, and in which:

Fig. 1 is a schematic diagram of a satellite broadcast system in which the present invention finds ready application;

Fig. 2 is a block diagram of a controlled-access broadcast digital video signal receiving system according to one embodiment of the present invention;

Fig. 3 is a block diagram of a controlled-access broadcast digital video signal receiving system according to another embodiment of the present invention;

Fig. 4 is a block diagram of a controlled-access broadcast digital video signal receiving system according to a further embodiment of the present invention;

Fig. 5 is a block diagram of a controlled-access broadcast digital video signal receiving system according to yet another embodiment of the present invention;

Fig. 6 is a flow diagram illustrating a communication and processing operation controlled by the controller of the controlled-access broadcast digital video signal receiving system of Fig. 2; and

Fig. 7 is another flow diagram illustrating another processing operation controlled by the controller of the controlled-access broadcast digital video signal receiving system of Fig. 2.

[0010] Figure 1 illustrates a satellite broadcast system incorporating a controlled-access broadcast signal receiving system 102 embodying the present invention. As explained in the following, it is preferred that the controlled-access broadcast signal receiving system 102 be specifically adapted to receive and process digital video data. Nevertheless, it should be appreciated that this system can be modified to accommodate other digital or analog signals. As it is understood that the system can easily be implemented to accommodate other types of data, the following explanation is specifically directed towards a controlled-access broadcast digital video signal receiving system 102.

[0011] The satellite television broadcasting system comprises a broadcasting station 101, the controlled-access broadcast digital video signal receiving system 102, an antenna 103, a video display 105, a communication link 106, and a satellite 107. The broadcasting station 101 broadcasts video signals and access-control signals to the controlled-access broadcast digital video signal receiving system 102 which processes the video signals as a function of the access-control signals.

[0012] The broadcasting station 101 transmits video and access-control signals to the receiving system 102 via the communication link 106, the satellite 107, or both. The communication link 106 is a signal transmission medium that couples broadcasting station 101 and receiving system 102. Preferably, communication link 106 comprises a conventional telephone line. Alternatively, communication link 106 includes any of a number of other transmission media, such as a land-based broadcast system, a cable television system, a fiber

optic network or the like.

[0013] Satellite 107 is a satellite broadcast signal relay station that receives signals from broadcasting station 101 and relays the signals to antenna 103. Antenna 103 receives signals from satellite 107 and supplies the signals to receiving system 102. Alternatively, satellite 107 can be replaced by any of a number of other transmission media, such as a land-based broadcast system, a cable television system, a fiber optic network or the like.

[0014] Receiving system 102 receives video signals and access-control signals supplied by broadcasting station 101 and processes (e.g. descrambles, decodes, and records) the signals. Typically, video signals are recorded on a storage medium and subsequently reproduced for display. Alternatively, video signals are recorded on a storage medium and processed for display to a user substantially simultaneously. Access-control signals are stored in a memory or, alternatively, recorded on a storage medium which may be the same storage medium on which the video signals are recorded. In a preferred embodiment, receiving system 102 is adapted to receive a storage cassette 104 containing a tape on which video and access-control signals are recorded. Alternatively, storage cassette 104 comprises a tape for storing video signals and a separate memory, such as a memory chip included therein, for storing access-control signals. In other embodiments, receiving system 102 is adapted to receive any of a number of other storage media, such as a video disc, a magnetic media diskette, a compact disc or the like. Video display 105, which preferably is a conventional display device, is coupled to and receives video signals from receiving system 102 for display to a user.

[0015] In a preferred recording mode of operation, broadcasting station 101 transmits video signals to satellite 107 which relays the signals to antenna 103 from which the video signals are coupled to receiving system 102. Also, broadcasting station 101 transmits access-control signals through communication link 106 to the receiving system. Receiving system 102 processes and records the video signals as a function of the access-control signals.

[0016] In a preferred reproduction mode of operation, the receiving system retrieves the previously stored access-control signals and uses those access-control signals to control the reproduction and processing of the previously recorded video signals. The video signals are supplied to video display 105 or to another peripheral device (not shown).

[0017] An alternate satellite television broadcasting system according to the present invention comprises each of the elements described above except that only one of communication link 106 and satellite 107 is included. The alternate system is otherwise interconnected as in the above-described embodiment. Through the single transmission medium, broadcasting station 101 transmits both video signals and access-control signals to receiving system 102.

[0018] In another variation, receiving system 102 transmits program requests, payment information, or other signals to broadcasting station 101 through one of the transmission media. Typically, communication link 106 is used for this purpose.

[0019] A first embodiment of the controlled-access broadcast digital video signal receiving system 102 according to the present invention is illustrated in Fig. 2 as system 102A. Receiving system 102A, is adapted for receiving, descrambling, enciphering, recording, deciphering and decoding digital video signals; and is comprised of a tuner 20, a descrambler 21A, an encipherer 22, a recording/reproducing section 23A, a decipherer 25, a decoder 26, an access controller 28A, a user interface 30, and a modem 31.

[0020] Tuner 20 receives input digital video signals, selects particular digital video signals, and supplies the selected signals to descrambler 21A. Preferably, input digital video signals are satellite broadcast digital video signals acquired by satellite antenna 103 which is coupled to tuner 20. Alternatively, input digital video signals are acquired from another transmission medium that is coupled to tuner 20. Preferably, a user controls tuner 20 to select signals from among different input digital video signals. The selected video signals include a time reference signal and a date reference signal.

[0021] Descrambler 21A is coupled to tuner 20 and descrambles scrambled digital video signals supplied therefrom. As is well known in the art, transmitted video signals are commonly scrambled or coded by a signal provider to prevent unauthorized reception of the video signals. Descrambler 21A supplies an unscrambled version of the digital video signals to encipherer 22. Further, descrambler 21A is coupled to a clock 27 to supply the received time reference signal and the date reference signal thereto.

[0022] Encipherer 22 is coupled to descrambler 21A, recording/reproducing section 23A, and access controller 28A. When enabled by the access controller, encipherer 22 encrypts, according to an encryption key, descrambled video signals supplied by descrambler 21A to produce encrypted video signals. The encrypted video signals are supplied to recording/reproducing section 23A for recording. However, the encrypted video signals cannot be displayed by ordinary means. It is contemplated that the encryption key is prestored in encipherer 22, or is supplied by access controller 28A, or is included in the video signals or in the access-control signals supplied by broadcasting station 101. When disabled by access controller 28A, encipherer 22 passes descrambled video signals from descrambler 21A directly to section 23A without encryption.

[0023] Recording/reproducing section 23A, through a record/playback head 24, or the like, records on storage medium 40 video signals supplied by encipherer 22. Section 23A, through head 24, also reads previously recorded video signals from storage medium 40 and supplies the reproduced video signals to decipherer 25.

Preferably, section 23A is a digital video tape recording/reproducing device (VTR) and storage medium 40 is a video tape. However, other types of storage media are contemplated, such as optical, magnetic or magneto-optic disc, solid-state memory, or the like.

[0024] Decipherer 25 is coupled to decoder 26 and, when enabled by access controller 28A, is adapted to decrypt, according to an encryption key, encrypted signals supplied by recording/reproducing section 23A. It is contemplated that the encryption key is prestored in decipherer 25, or is supplied thereto by access controller 28A, or is included in the video signals or the access-control signals supplied by broadcasting station 101, or is stored in storage medium 40, or is stored in access condition memory 29. When disabled, decipherer 25 passes video signals from recording/reproducing section 23A directly to decoder 26 without decryption.

[0025] As is well known in the art, video signals are commonly compressed or otherwise coded to facilitate their transmission through a transmission medium. Decoder 26 decodes such coded digital video signals as reproduced from storage medium 40 to produce uncoded digital video signals which are coupled to video display 105 for display. It is preferred that decoder 26 is adapted to decode digital video signals encoded in accordance with the Moving Picture Image Coding Experts Group (MPEG) standard.

[0026] Clock 27 is comprised of a clock device and a date device for tracking the time of day and the calendar date, respectively, known to those of ordinary skill in the art. Clock 27 is coupled to access controller 28A and supplies time signals and date signals thereto. The clock receives a time reference signal and a date reference signal from descrambler 21A and synchronizes its operation therewith.

[0027] User interface 30 is coupled to access controller 28A and supplies user input signals thereto. The user input signals are generated as a function of input supplied by a user to the user interface which may include a keyboard or user-operated switches. Typical user input signals include a command to display video signals, a command to record broadcast video signals, an authorization code, a request for a specific video program, and so on.

[0028] Modem 31 is coupled to access controller 28A and to communication link 106 and facilitates the communication of signals through the communication link between broadcasting station 101 (shown in Fig. 1) and the access controller. As communication link 106 is preferably a telephone line, modem 31 is preferably a conventional telephone line modem.

[0029] Access controller 28A is further coupled to an access condition memory 29. It will be appreciated that, as a function of the signals supplied to access controller 28A by clock 27, user interface 30, modem 31, and access condition memory 29, the access controller controls the operation of encipherer 22 and decipherer 25. As will be discussed in greater detail below, depending

upon whether applicable conditions have been fulfilled, the access controller enables or disables the operation of encipherer 22 and decipherer 25. Access controller 28A stores access-control signals in and retrieves access-control signals from access condition memory 29. In an alternate embodiment, it is contemplated that the access controller 28A stores both access-control signals and the encryption keys of encipherer 22 and decipherer 25 in access condition memory 29.

[0030] Access-control signals indicate the conditions, if any, to be placed on the reproduction of the video component of the selected digital video signals. These conditions describe the circumstances under which a user may or may not reproduce the selected video signals. As a function of the access-control signals, the selected video signals recovered by descrambler 21A are processed prior to recording and processed again following reproduction. Depending on the particular conditions and circumstances, a user can be prevented entirely from accessing the selected digital video signals, given limited access to the signals, or given full access to the signals. Such conditions may include, but are not limited to, one or more of the following: (1) previous receipt of a payment signal from broadcasting station 101, (2) a numerical limit on the number of times particular video signals may be reproduced or displayed, (3) a temporal limit on the reproduction or display of video signals, and (4) previous receipt of a user authorization code. Preferably, the access-control signals are comprised of simple default values.

[0031] Also illustrated in Fig. 2 is storage cassette 104A which comprises access condition memory 29 and storage medium 40. Storage cassette 104A is, as a whole, removably connected to receiving system 102A. Access condition memory 29 stores access-control signals indicating the conditions, if any, to be placed on the reproduction and/or recording of video signals on storage medium 40. Preferably, access condition memory 29 is an integrated circuit RAM, integrated into storage cassette 104A but independent of storage medium 40, as has been proposed heretofore, and electrically connectable to access controller 28A. Storage medium 40 stores signals recorded thereon by head 24 and is preferably removably engaged therewith.

[0032] Operation of the embodiment of the controlled-access broadcast digital video signal receiving system 102A shown in Fig. 2 will be described below. An important feature of this embodiment is that access-control signals, corresponding to video signals that are to be recorded on or reproduced from storage medium 40, are stored in access condition memory 29. Access controller 28A controls the operation of encipherer 22 and decipherer 25 as a function of one or more of the access-control signals stored in access condition memory 29 and/or received from modem 31. In this manner, the encryption and decryption of video signals is controlled to prevent unauthorized reproduction of the video signals.

[0033] The configuration of the present invention is compatible with many different sequences of signal transfer between broadcasting station 101 and receiving system 102A. Examples of useful signal transfer sequences, implemented in different modes of operation of the present invention, will be described in detail below. Through the different modes of operation, video programs are securely transferred between a broadcaster and a consumer for recording, but the consumer's ability to display the programs can be subjected to limitations.

[0034] In a first video-on-demand mode, a user enters into user interface 30 a request for a specific video program. User interface 30 transmits this request to access controller 28A, which, in turn, communicates the user's request through modem 31 and communication link 106 to broadcasting station 101. The broadcasting station transmits the requested video program to satellite 107 which relays the video program to antenna 103 and supplies the video signals representing this program to tuner 20. It is expected that several video signals are coupled to tuner 20, which selects the particular video signals comprising the requested video program and supplies these selected video signals to descrambler 21A. The descrambler descrambles these broadcast video signals and supplies a descrambled version of the video signals to encipherer 22. Descrambler 21A also supplies a time reference signal and a date reference signal, which accompany the video program transmission, to clock 27.

[0035] Additionally, broadcasting station 101 communicates access-control signals through communication link 106 and modem 31 to access controller 28A for storage in access condition memory 29. The access-control signals serve to define the conditions or limitations, if any, upon the usage of the requested video program. In general, a user can either purchase or rent a particular video program from a broadcaster. In a prepayment method of purchase, a user pays for a video program and subsequently requests that the broadcaster transmit the program to the user's video receiving system. Broadcasting station 101 transmits the requested program and an access-control signal indicating that the video program can be unconditionally recorded and reproduced (FULL ACCESS). Access controller 28A stores the FULL ACCESS signal in access condition memory 29 to disable encipherer 22. Hence, descrambled video signals of the video program are supplied by descrambler 21A through encipherer 22, without encryption, to recording/reproducing section 23A, whereat the descrambled and unencrypted video signals are recorded on storage medium 40.

[0036] In a postpayment method of purchase, wherein a user elects to pay for a video program after it has been received by the user's receiving system, broadcasting station 101 transmits the particular video program to receiving system 102A along with an access-control signal indicating that the video program cannot be

reproduced (NO REPRO). Access controller 28A stores the NO REPRO signal in access condition memory 29 and enables encipherer 22, causing it to encrypt, according to an encryption key, descrambled video signals of the video program supplied by descrambler 21A. Encipherer 22 supplies encrypted video signals to recording/reproducing section 23A, whereat the encrypted video signals are recorded on storage medium 40.

[0037] It is contemplated that the user subsequently purchases the video program from the broadcaster. Upon payment, broadcasting station 101 transmits an access-control signal to access controller 28A indicating that the recorded video program can be reproduced (REPRO OK), and this REPRO OK signal replaces the previously stored NO REPRO signal in memory 29. When the encrypted video signals subsequently are played back from storage medium 40, they are supplied to decipherer 25 which is enabled by the stored REPRO OK signal to decrypt the reproduced video signals.

[0038] In a second prepayment method of purchase, similar to the postpayment method, the user pays for the selected program prior to its transmission, but broadcasting station 101 first transmits the selected program to receiving system 102A along with a NO REPRO signal. Access controller 28A causes encipherer 22 to encrypt the video signals of the video program and the encrypted signals are recorded on storage medium 40 while the NO REPRO signal is stored in access condition memory 29. Upon completion of the video program transmission, broadcasting station 101 transmits a REPRO OK signal; and access controller 28A replaces the stored NO REPRO signal with the REPRO OK signal. Thus, the video program is recorded in encrypted form but the user can reproduce and decrypt the program an unlimited number of times. This second prepayment method has the advantage of producing video recordings that can only be reproduced in devices having compatible decryption capabilities.

[0039] Alternatively, a user can purchase the right to reproduce a video program a certain number (N) of times. The user thus "rents" the video program for N reproductions. In one mode, the user enters a request into user interface 30 to rent a video program for N reproductions. User interface 30 transmits the request to access controller 28A which forwards the request through modem 31 and communication link 106 to broadcasting station 101. Broadcasting station 101 transmits the requested video program along with an access-control signal indicating that the video program can only be reproduced N times (REPRO N TIMES). The access controller receives the REPRO N TIMES signal and stores it in access condition memory 29. The video program is received by tuner 20 and supplied to descrambler 21A which descrambles the video program and supplies descrambled video signals to encipherer 22. The encipherer, which is enabled by the access controller, encrypts the descrambled video signals, and

supplies encrypted signals to recording/reproducing section 23A for recording on storage medium 40.

[0040] In another rental mode, wherein a user desires to rent a particular video program for a certain period of time, an access-control signal designating the period of time during which reproduction of the requested video program is authorized is supplied by the broadcasting system. For example, the user may request to rent a particular video program for a certain number of days (D). Receiving system 102A transmits this request via communication link 106 to broadcasting station 101. The broadcasting station calculates the date Y, as a function of D, on which the reproduction right should expire, and transmits the requested video program along with an access-control signal indicating that reproduction is allowed until date Y (REPRO UNTIL DATE Y). The access-control signal is received by receiving system 102A and stored in access condition memory 29. The access controller enables the operation of encipherer 22; and as described above, the requested video program is received, selected by tuner 20, descrambled, enciphered, and recorded in enciphered form. Subsequently, the encrypted video program is reproduced, deciphered (so long as the reproduction operation is performed prior to date Y) and displayed.

[0041] As another example, a user can request to rent a particular video program for a certain number of hours (H). Receiving system 102A transmits this request via communication link 106 to broadcasting station 101 which calculates the time T, as a function of H, when the reproduction right should expire, and transmits the requested video program along with an access-control signal indicating that reproduction is allowed until time T (REPRO UNTIL TIME T). The received access-control signal is stored in access condition memory 29; and the operation of encipherer 22 is enabled by access controller 28A. As described above, the requested video program is received, selected, descrambled, enciphered, and recorded in an enciphered form.

[0042] Of course, there are many different methods of expressing the terms of a rental. The preceding expressions are intended merely as examples to assist in explaining the present invention and not as limits thereon. Further examples of useful rental terms include: reproduction of a video program for a certain number of hours or of days, or for a period of time in the future.

[0043] Analogous to the prepayment and postpayment methods of purchase, each rental of a video program can be prepaid or postpaid by the user. When the rental is prepaid, broadcasting station 101 transmits the requested program and the access-control signal specifying the terms of the rental to receiving system 102A which processes the video program (i.e., selectively encrypts the video signals) and stores the access-control signal as described above.

[0044] In contrast, when the rental is postpaid, broadcasting station 101 transmits the requested program

and a NO REPRO signal to receiving system 102A, which encrypts and records the video program and stores the NO REPRO signal as described above. Upon proper payment, broadcasting station 101 transmits the access-control signal specifying the terms of the rental to the receiving system which replaces the NO REPRO signal in access condition memory 29 with the newly-transmitted access-control signal.

[0045] In a further variation, a certain segment of the video program can be made available for reproduction by a user in a "preview" mode of operation. In this "preview" mode a user can view a selected portion of the requested video program and later decide whether or not to purchase or rent the entire video program. In an illustrative implementation of the preview mode, the access-control signal corresponding to the preview segment is a REPRO OK signal and the access-control signal corresponding to the entire video program is a NO REPRO signal.

[0046] In a second video-on-demand mode, a user requests video programming from a broadcaster to be transmitted at a later time, perhaps the following day. The video programming may be, for example, one or more video programs selected by the user or a number of video programs selected by the broadcaster. In the latter case, it is contemplated that the user initially selects a particular type of video programming or selects video programming provided by a particular video program supplier.

[0047] The request for "delayed" transmission of the video programming is entered by the user into user interface 30. User interface 30 transmits this request to access controller 28A which communicates the user's request through modem 31 and communication link 106 to broadcasting station 101.

[0048] Some period of time later, broadcasting station 101 transmits the requested video programming to satellite 107 which relays the video programming to antenna 103. Preferably, transmission of the video programming occurs during periods when broadcasters are "off-the-air" or during periods of low viewership of broadcast video signals. Antenna 103 receives the video programming and supplies the video signals to tuner 20 from which the particular video signals comprising the requested video programming are supplied to descrambler 21A which, in turn, supplies a descrambled version of the video signals to encipherer 22.

[0049] In this mode, broadcasting station 101 also transmits two access-control signals via communication link 106 and modem 31 to access controller 28A. One access-control signal indicates that the video programming is to be erased on a certain date Y (ERASE ON DATE Y) and the other access-control signal is the NO REPRO signal. Access controller 28A stores the ERASE ON DATE Y signal and the NO REPRO signal in access condition memory 29. Encipherer 22, when enabled, supplies encrypted video signals to recording/reproducing section 23A for recording on storage

medium 40.

[0050] Subsequently, but prior to date Y, the user selects a video program from the requested video programming stored on storage medium 40 and pays the fee to rent the selected program for a particular rental term. Upon payment, broadcasting station 101 transmits the access-control signal indicating the appropriate rental condition to access controller 28A which replaces the previously stored NO REPRO signal in memory 29. Hence, the ERASE ON DATE Y signal remains stored in access condition memory 29.

[0051] Illustrative video signal reproduction modes of operation of receiving system 102A now will be described. The process is initiated when a user enters a command into user interface 30 to reproduce a prestored video program recorded on storage cassette 104A. The user interface transmits the command to access controller 28A which retrieves the access-control signal stored in access condition memory 29 of the storage cassette. The operation of decipherer 25 is controlled as a function of the particular access-control signal(s) that is retrieved.

[0052] If, for example, the retrieved signal is a FULL ACCESS signal, then access controller 28A disables decipherer 25. Recording/reproducing section 23A recovers video signals from storage medium 40 and supplies the reproduced video signals to decipherer 25, which passes the video signals to decoder 26. As described above, the reproduced video signals are unencrypted; and decoder 26 decodes the video signals and supplies uncoded video signals to video display 105.

[0053] If the NO REPRO signal is retrieved from access condition memory 29, access controller 28A disables the operation of decipherer 25. However, unlike the FULL ACCESS signal case, the video signals stored on storage medium 40 are encrypted. Hence, recording/reproducing section 23A reproduces encrypted video signals which are supplied to decipherer 25 to be passed directly to decoder 26 without decryption. The decoder decodes the encrypted video signals to produce uncoded but encrypted video signals which are supplied to video display 105. As a result, the video display either cannot display the video signals at all or can only display a distorted version of the original video program.

[0054] As a further alternative, access controller 28A may retrieve a REPRO OK signal from access condition memory 29 to enable the operation of decipherer 25. Recording/reproducing section 23A reproduces the encrypted video signals stored on storage medium 40 and supplies the encrypted signals to enabled decipherer 25 which decrypts the video signals and supplies unencrypted video signals to decoder 26. The decoder decodes the video signals and supplies the resulting uncoded and decrypted video signals to video display 105 for display. Because the video signals are uncoded and decrypted, video display 105 displays the repro-

duced video program without distortion.

[0055] As yet another alternative, when access controller 28A retrieves a REPRO N TIMES signal from access condition memory 29, the access controller 28A determines whether the number N is greater than a predetermined threshold value (e.g. zero). If the number N is not greater than the threshold value, then access controller 28A disables operation of decipherer 25 and reproduction of the stored video signal proceeds as in the NO REPRO signal case. On the other hand, if the number N is greater than the threshold value, then access controller 28A enables decipherer 25 and reproduction of the stored video signal proceeds as in the REPRO OK signal case.

[0056] After the video signal is reproduced from storage medium 40, if the number N is greater than the threshold value, access controller 28A subtracts one from the value of N to produce a new value N and writes a new REPRO N TIMES signal, utilizing the new value N, into access condition memory 29 whereat the previously stored REPRO N TIMES signal is replaced by the new REPRO N TIMES signal. According to this procedure, the particular video signals stored in storage medium 40 to which the REPRO N TIMES signal corresponds are only reproduced the number of times represented by the number N. The value N stored in access condition memory 29 thus reflects the remaining number of permitted reproductions of the particular video signals. Since the access condition memory is provided in the same storage cassette 104A as storage medium 40, and the video signals are encrypted on the storage medium, the video signals can only be reproduced for display N times even if the cassette is loaded into another receiving system, at least until a new access-control signal is stored.

[0057] When, as described above, a video program is rented for only a certain period of time, access controller 28A retrieves the corresponding access-control signal from access condition memory 29 and also receives a clock signal and a date signal from clock 27. The clock signal and the date signal are compared to the retrieved access-control signal, and if the particular condition expressed in the access-control signal is satisfied such that reproduction is allowed, then decipherer 25 is enabled and reproduction of the stored video signals proceeds as in the REPRO OK case. However, if the condition expressed by the access-control signal is not satisfied such that reproduction of the video signals is not allowed, then the decipherer is disabled and reproduction of the stored video signals proceeds as described with respect to the NO REPRO signal.

[0058] For example, when access controller 28A retrieves a REPRO UNTIL DATE Y signal from access condition memory 29, it compares the date signal from clock 27 to the date Y. If the date from clock 27 is prior to date Y, then the access controller enables the operation of decipherer 25 to decrypt the reproduced, encrypted video signals. In a similar fashion, when the

access controller retrieves a REPRO UNTIL TIME T signal from the access condition memory, it compares the time signal supplied by clock 27 with the time T. If the time indicated by the time signal is prior to time T, then reproduction of the stored video signals proceeds as described with respect to the REPRO OK signal.

[0059] In an analogous manner, when access controller 28A retrieves an ERASE ON DATE Y signal from access condition memory 29, it compares the date signal from clock 27 to the date Y. If the date indicated by clock 27 is the same as or past date Y, then the access controller controls recording/reproducing section 23A to erase the video signals stored on storage medium 40. A suitable control channel, or link, may be provided between access controller 28A and recording/reproducing section 23A.

[0060] An alternate embodiment of receiving system 102A additionally includes a connection between descrambler 21A and access controller 28A. Here, scrambled access-control signals that are transmitted by broadcasting station 101 along with the video signals are supplied to and descrambled by descrambler 21A from which they are coupled to the access controller. In this alternate embodiment, video signals are recorded and reproduced as described above, and encipherer 22 and decipherer 25 are selectively enabled and disabled in response to the received access-control signals in the same manner as has been discussed.

[0061] As will be appreciated by one of ordinary skill in the art, each of the abovedescribed modes of signal reproduction wherein the user has prepaid for the video programming can be achieved substantially simultaneously with the recording of the broadcast video signals. In such a mode of operation, recording/reproducing section 23A functions both to record the processed broadcast video signals and to supply the video signals to decipherer 25. Decipherer 25, controlled by access controller 28A, decrypts the video signals as a function of the access-control signal to be stored in access condition memory 29 and decoder 26 decodes the resulting video signals for immediate display on video display 105.

[0062] Another embodiment of the controlled-access broadcast digital video signal receiving system 102B according to the present invention is illustrated in Fig. 3. Receiving system 102B differs from abovedescribed receiving system 102A in that receiving system 102B stores access-control signals and video signals in the same storage medium 40 of storage cassette 104B.

[0063] Recording/reproducing section 23B, through head 24, records on storage medium 40 in storage cassette 104B video signals supplied by encipherer 22 and access-control signals supplied by access controller 28B; and also reads previously recorded video signals and previously recorded access-control signals from the storage medium. The reproduced video signals are supplied to decipherer 25 and the reproduced access-control signals are supplied from the recording/reproducing

section to access controller 28B. As before, recording/reproducing section 23B is a digital video tape recording/reproducing device (VTR) and storage medium 40 is a video tape; although the storage medium may be a magnetic disc, an optical disc, a magneto-optic disc, a solid-state device, or other recordable medium. It is also preferred that the access-control signals be stored in one or more sub-code regions of the storage medium.

[0064] When enabled by access controller 28B, decipherer 25 decrypts, according to an encryption key, encrypted signals reproduced by recording/reproducing section 23B. It is contemplated that the encryption key is prestored in the decipherer or is supplied thereto by access controller 28B, or is included in the video signals or the access-control signals supplied by broadcasting station 101, or is stored in and read from storage medium 40. When disabled, decipherer 25 passes video signals from recording/reproducing section 23B directly to decoder 26 without decrypting such signals.

[0065] As a function of the signals supplied to access controller 28B by clock 27, user interface 30, modem 31, and recording/reproducing section 23B, the access controller controls the operation of encipherer 22 and decipherer 25 as has been described previously. Specifically, depending upon whether applicable conditions have been fulfilled, the access controller enables or disables the operation of encipherer 22 and decipherer 25.

[0066] Each signal transfer sequence, including variations thereon, described above with respect to receiving system 102A is also implemented in similar modes of operation of receiving system 102B. It will be appreciated, then, that the modes of operation of receiving system 102B are substantially identical to the modes of operation of receiving system 102A with the following illustrative exceptions. Access controller 28B functions in the same manner as access controller 28A, except that access-control signals are stored, through recording/reproducing section 23B, in storage medium 40, instead of in a separate access condition memory. Recording/reproducing section 23B functions in the same manner as section 23A except that section 23B additionally records access-control signals on and reproduces access-control signals from storage medium 40. The reproduced access-control signals are supplied from recording/reproducing section 23B to access controller 28B.

[0067] Similar to the alternate embodiment discussed in conjunction with Fig. 2, an alternate embodiment of receiving system 102B additionally includes a connection between descrambler 21A and access controller 28B so that scrambled access-control signals that are transmitted by broadcasting station 101 along with the video signals are descrambled and supplied to the access controller. Of course, access controller 28B uses these access-control signals in the same manner as discussed above.

[0068] A further embodiment of the controlled-access

broadcast digital video signal receiving system 102C according to the present invention is illustrated in Fig. 4. Receiving system 102C, is adapted for receiving, descrambling, decoding, recording, and reproducing digital video signals and is similar to the aforescribed receiving system 102A of Fig. 2. As in receiving system 102A, receiving system 102C stores access-control signals in access condition memory 29 of storage cassette 104A, while the video signals are stored on storage medium 40 of the storage cassette.

[0069] Fig. 4 differs from Fig. 2 in that descrambler 21C of receiving system 102C is coupled to access controller 28C, recording/reproducing section 23A, and decoder 26; and encipherer 22 and decipherer 25 are not provided as separate circuits. When enabled by access controller 28C, descrambler 21C descrambles video signals supplied by tuner 20 and supplies an unscrambled version of the digital video signals to recording/reproducing section 23A. Also, when enabled by the access controller, descrambler 21C descrambles video signals reproduced by recording/reproducing section 23A and supplies an unscrambled version of the digital video signals to decoder 26. When disabled by access controller 28C, descrambler 21C passes scrambled video signals from tuner 20 directly, without encryption, to section 23A and also passes video signals reproduced by the recording/reproducing section directly, without decryption, to decoder 26. Scrambled video signals can be recorded but they cannot be displayed in scrambled form.

[0070] It will be appreciated that access controller 28C functions in the same general manner as access controller 28A, except that descrambler 21C is controlled in accordance with the access-control signals rather than encipherer 22 and decipherer 25.

[0071] At those aforescribed operational steps where access controller 28A enables encipherer 22, access controller 28C disables descrambler 21C to pass scrambled signals to the recording/reproducing section; and where access controller 28A disables encipherer 22, access controller 28C enables descrambler 21C to supply descrambled signals to the recording/reproducing section. However, in the operational steps where access controller 28A enables decipherer 25, access controller 28C similarly enables descrambler 21C to descramble the signals reproduced by the recording/reproducing section. Where access controller 28A disables decipherer 25, access controller 28C similarly disables descrambler 21C to pass to decoder 26 signals reproduced by the recording/reproducing section.

[0072] In an alternate embodiment of receiving system 102C, access-control signals, transmitted by broadcasting station 101 along with video signals, are received through antenna 103 and supplied by tuner 20 to descrambler 21C for descrambling and for coupling to access controller 28C.

[0073] A still further embodiment of the controlled-

access broadcast digital video signal receiving system 102D according to the present invention is illustrated in Fig. 5. Receiving system 102D is seen to be a combination of portions of receiving system 102C and receiving system 102B (Fig. 3). Similar to receiving system 102B, receiving system 102D stores access-control signals and video signals in the same storage medium 40 of storage cassette 104B. Recording/reproducing section 23B supplies the reproduced video signals to descrambler 21C and supplies the reproduced access-control signals to access controller 28D.

[0074] It will be appreciated that the modes of operation of receiving system 102D are substantially similar to the modes of operation of receiving system 102C with the following illustrative exceptions. Access controller 28D functions in the same manner as access controller 28C, except that access-control signals are stored in storage medium 40 instead of in a separate access condition memory. Recording/reproducing section 23B functions in the same manner as section 23A except that section 23B additionally records access-control signals on and reproduces access-control signals from storage medium 40. The reproduced access-control signals are supplied from recording/reproducing section 23B to access controller 28D.

[0075] Similar to the alternate embodiment discussed in conjunction with Fig. 4, access-control signals, transmitted by broadcasting station 101 along with video signals, are received through antenna 103 and supplied by tuner 20 to descrambler 21C for descrambling; and the descrambled access-control signals are supplied to access controller 28D. It is seen that access controller 28D receives access-control signals from recording/reproducing section 23B and either from modem 31 or from descrambler 21C, or from both.

[0076] Fig. 6 is a flow diagram of a preferred mode of operation of receiving system 102A of Fig. 2, as controlled by access controller 28A, wherein a user orders from a broadcaster a limited or an unlimited right (as may be desired) to reproduce a video program. The user initiates the process by entering a request for a particular video program at user interface 30. The process begins at step S60, where access controller 28A causes modem 31 to connect to broadcasting station 101.

[0077] Access controller 28A transmits identification information through modem 31 and communication link 106 to broadcasting station 101 which checks the identification information against a subscription list and determines whether the user has subscribed to the broadcasting station's service, as represented by inquiry S61. If the user is not subscribed, the broadcasting station terminates the connection with receiving system 102A in step S62.

[0078] If the user is subscribed, inquiry S61 is answered in the affirmative and operation continues to inquiry S63, which polls the user to determine whether or not the video program is to be purchased. If the user

enters an affirmative response into user interface 30, operation proceeds to inquiry S64. Otherwise, operation proceeds to inquiry S65.

[0079] At inquiry S64, the broadcasting station 101 determines whether the user has prepaid for the video program and if not, the user is further queried to determine if payment will be made at that time. If the price of the video program has been previously paid or is immediately paid, then processing proceeds with step S66. Otherwise, processing proceeds with step S67.

[0080] In step S66, broadcasting station 101 transmits the video program via satellite to antenna 103 and transmits the FULL ACCESS signal via communication link 106 and modem 31 to access controller 28A. Access controller 28A disables encipherer 22, allowing the video program to be recorded in an unencrypted form on storage medium 40, and the access controller also stores the FULL ACCESS signal in access condition memory 29.

[0081] In step S67, broadcasting station 101 transmits the video program via satellite to antenna 103 and transmits the NO REPRO signal via communication link 106 and modem 31 to access controller 28A. The access controller enables encipherer 22, causing the video program to be encrypted and then recorded in encrypted form on storage medium 40, and the NO REPRO signal is stored in access condition memory 29.

[0082] If the video program is not to be purchased, resulting in a negative answer to inquiry S63, the operation proceeds to inquiry S65 whereat the user is polled to determine whether the video program is to be rented for a number (N) of viewings. If the user enters an affirmative response into user interface 30, the number N is entered, and operation proceeds to inquiry S69. Otherwise, operation proceeds to inquiry S68.

[0083] At inquiry S69, the broadcasting station 101 determines whether the user has prepaid for the N viewings of the video program and if not, the user is further queried to determine if payment will be made at that time. If the fee for N viewings of the video program has been previously paid or is immediately paid, processing proceeds with step S71. Otherwise, processing proceeds with step S72.

[0084] In step S71, broadcasting station 101 transmits the video program via satellite to antenna 103 and transmits the REPRO N TIMES signal via communication link 106 and modem 31 to access controller 28A. The access controller 28A enables encipherer 22, causing the video program to be encrypted and then recorded on storage medium 40; and the REPRO N TIMES signal is stored in access condition memory 29.

[0085] In step S72, broadcasting station 101 transmits the video program via satellite to antenna 103 and transmits the NO REPRO signal via communication link 106 and modem 31 to access controller 28A. The access controller enables encipherer 22, causing the video program to be encrypted and then recorded on storage medium 40; and the NO REPRO signal is

scored in access condition memory 29.

[0086] If the video program is not to be rented for N viewings, inquiry S65 is answered in the negative and the operation proceeds to inquiry S68 whereat the user is polled to determine whether a video program is to be rented for viewing until a date Y. If the user enters an affirmative response into user interface 30, the date Y is entered, and operation proceeds to inquiry S70. Otherwise, operation returns step S62, described above.

[0087] At inquiry S70, the broadcasting station 101 determines whether the user has prepaid for the rental of the video program until date Y and if not, the user is further queried to determine if payment will be made at that time. If the fee for the rental period has been previously paid or is immediately paid, then processing proceeds with step S73. Otherwise, processing proceeds with step S72, described above.

[0088] In step S73, broadcasting station 101 transmits the video program via satellite to antenna 103 and transmits the REPRO UNTIL DATE Y signal via communication link 106 and modem 31 to access controller 28A. The access controller enables encipherer 22, causing the video program to be encrypted and then recorded in encrypted form on storage medium 40. Access controller 28A also stores the REPRO UNTIL DATE Y signal in access condition memory 29.

[0089] Fig. 7 is a flow diagram of a preferred mode of operation of receiving system 102A of Fig. 2 wherein a user seeks to reproduce a selected previously recorded video program. The user initiates the process by supplying a request to reproduce a prerecorded video program at user interface 30 and the process begins at step S80, where access controller 28A retrieves from access condition memory 29 the access-control signal corresponding to the selected video program. The process proceeds to inquiry S81 whereat the access controller determines if the access-control signal is the NO REPRO signal. If so, processing proceeds with step S86; otherwise, processing proceeds to inquiry S82.

[0090] In step S86, access controller 28A causes modem 31 to connect to broadcasting station 101 and transmits identification information and program information to the broadcasting station. Processing then proceeds to inquiry S88 which queries the user to determine if payment of the full purchase price for the video program will be made at that time. If the purchase price of the video program is paid, then processing proceeds with step S93. Otherwise, processing proceeds to inquiry S89.

[0091] In step S93, broadcasting station 101 transmits the REPRO OK signal via communication link 106 and modem 31 to access controller 28A which stores the REPRO OK signal in access condition memory 29, replacing the NO REPRO signal, and processing proceeds to step S97. In step S97, the access controller enables decipherer 25; and the selected video program which is reproduced from storage medium 40 is decrypted by decipherer 25, decoded by decoder 26,

and supplied for display to video display 105.

[0092] If the retrieved access-control signal is not the NO REPRO signal, as represented by a negative answer to inquiry S81, inquiry S82 determines whether the access-control signal is the REPRO N TIMES signal. If so, processing proceeds with step S94. Otherwise, processing proceeds to inquiry S83. In step S94, access controller 28A decrements N by one, debiting the single reproduction which will immediately follow. Further, the REPRO N-1 TIMES signal is stored in access condition memory 29, replacing the access-control signal previously stored there, and processing proceeds to step S97 to reproduce and decrypt the video signal, described above.

[0093] If the retrieved access-control signal is not the REPRO N TIMES signal, inquiry S83 is made to determine if the access-control signal is the REPRO UNTIL DATE Y signal. If so, processing proceeds to inquiry S87. Otherwise, processing proceeds to inquiry S84. Inquiry S87 compares the date signal supplied by clock 27, indicating the current date, with date Y. If the current date is prior to date Y, then processing proceeds to step S97, described above. Otherwise, processing proceeds to step S90, whereat access controller 28A determines that the applicable condition has not been satisfied and therefore no video signal reproduction is authorized. The access controller thereafter terminates the connection with broadcasting station 101.

[0094] If the retrieved access-control signal is neither the NO REPRO nor the REPRO N TIMES nor the REPRO UNTIL DATE Y signal, inquiry S84 determines if the access-control signal is the REPRO OK signal. If it is, processing proceeds with step S97, described above. Otherwise, processing advances to inquiry S85 whereat access controller 28A determines if the access-control signal is the FULL ACCESS signal. If so, processing proceeds with step S96. Otherwise, processing proceeds with step S92.

[0095] In step S92, access controller 28A determines that it has failed to recognize the particular access-control signal stored in condition access memory 29, if any. Lacking a recognizable access-control signal, no video signal reproduction is authorized. Access controller 28A terminates the connection with broadcasting station 101. It should be appreciated that step S92 can be replaced with additional access-control signal definitions to provide further processing and access-control signal permutations.

[0096] In step S96, access controller 28A disables decipherer 25, and recording/reproducing section 23A reproduces the selected video program from storage medium 40. The reproduced video program passes through decipherer 25 for decoding by decoder 26, and is supplied to video display 105 for display.

[0097] If the retrieved access-control signal is the NO REPRO signal and payment of the full purchase price is not made, inquiry S88 is answered in the negative and the process advances to inquiry S89, which queries the

user to determine if the fee for N viewings of the video program will be paid. If the fee for N viewings of the video program is paid, then broadcasting station 101 transmits the REPRO N TIMES signal via communication link 106 and modem 31 to access controller 28A, and processing proceeds with step S94, described above. Otherwise, processing proceeds to inquiry S91 which queries the user to determine if the fee for rental of the video program until date Y will be paid. If the fee for such a rental is paid, then processing proceeds with step S95. Otherwise, processing proceeds with step S90, described above.

[0098] In step S95, broadcasting station 101 transmits the REPRO UNTIL DATE Y signal via communication link 106 and modem 31 to access controller 28A which stores the REPRO UNTIL DATE Y signal in access condition memory 29, replacing the NO REPRO signal, and processing proceeds to step S97, described above.

[0099] Those of ordinary skill in the art will readily appreciate the modifications to be made to the flow diagrams of Figs. 6 and 7 to control the operation of the controlled-access broadcast video signal recording systems shown in Figs. 3, 4 and 5. Hence, in the interest of brevity, further description of such modified flow diagrams is not made.

[0100] Although illustrative embodiments of the present invention and modifications thereof have been described in detail herein, it is to be understood that this invention is not limited to these precise embodiments and modifications, and that other modifications and variations may be effected therein by one skilled in the art. For example, it is contemplated that a broadcast video program can be processed by an apparatus embodying the present invention for display to a user without a preceding or simultaneous recording of the video program.

Claims

1. Apparatus for receiving digital broadcast signal which is scrambled, the apparatus comprising:

receiving means (20) for receiving said digital broadcast signal;
descrambling means (21A), coupled to said receiving means (20), for descrambling said received digital broadcast signal;
encrypting means (22) for encrypting said descrambled digital broadcast signal in order to record said digital broadcast signal on a recording medium; and
decrypting means (25) for decrypting said encrypted broadcast signal which is reproduced from said recording medium.

2. Apparatus according to claim 1, wherein said broadcast signal includes an access-control signal, said encrypting means being controlled in response to said access-control signal.

3. Apparatus according to claim 2, wherein said access control signal is recorded on said recording medium.
4. Apparatus according to claim 1, 2 or 3, further comprising a clock means for tracking the time of day and the calendar date; wherein said broadcast signal includes a time reference signal and date reference signal, said clock means is controlled to synchronize its operation with said time reference signal and date reference signal. 5
10
5. Apparatus according to any preceding claim wherein said broadcast signals are video data signals. 15
6. Apparatus according to any of claims 2 to 5, wherein said receiving means (20, 31) is operable to receive said broadcast signals and said access-control signal from a broadcasting station (101). 20
7. Apparatus according to any preceding claim, wherein said receiving means comprises a tuner (20). 25
8. Apparatus according to any of claims 2 to 7, wherein said receiving means comprises a modem (31) for receiving said access-control signal.
9. Apparatus according to any of claims 2 to 8, wherein said receiving means comprises a user interface (30) for receiving said access-control signal from a user. 30
10. Apparatus according to any preceding claim, wherein said recording medium is a video tape. 35
11. Apparatus according to any of claims 1 to 10, further comprising control means (28A) being operable to control encrypting means (22) and decrypting means (25) as a function of said access-control signal. 40
12. Apparatus according to any of claims 2 to 11, wherein said broadcast signals are stored on said recording medium (40), and said access-control signal is stored in a separate storage medium (29). 45
13. Apparatus according to claim 12, in which said separate storage medium is an integrated circuit memory (29). 50
14. Apparatus according to any of claims 2 to 11, wherein said broadcast signals and said access-control signals, are both stored on a common recording medium (40). 55

Fig. 1

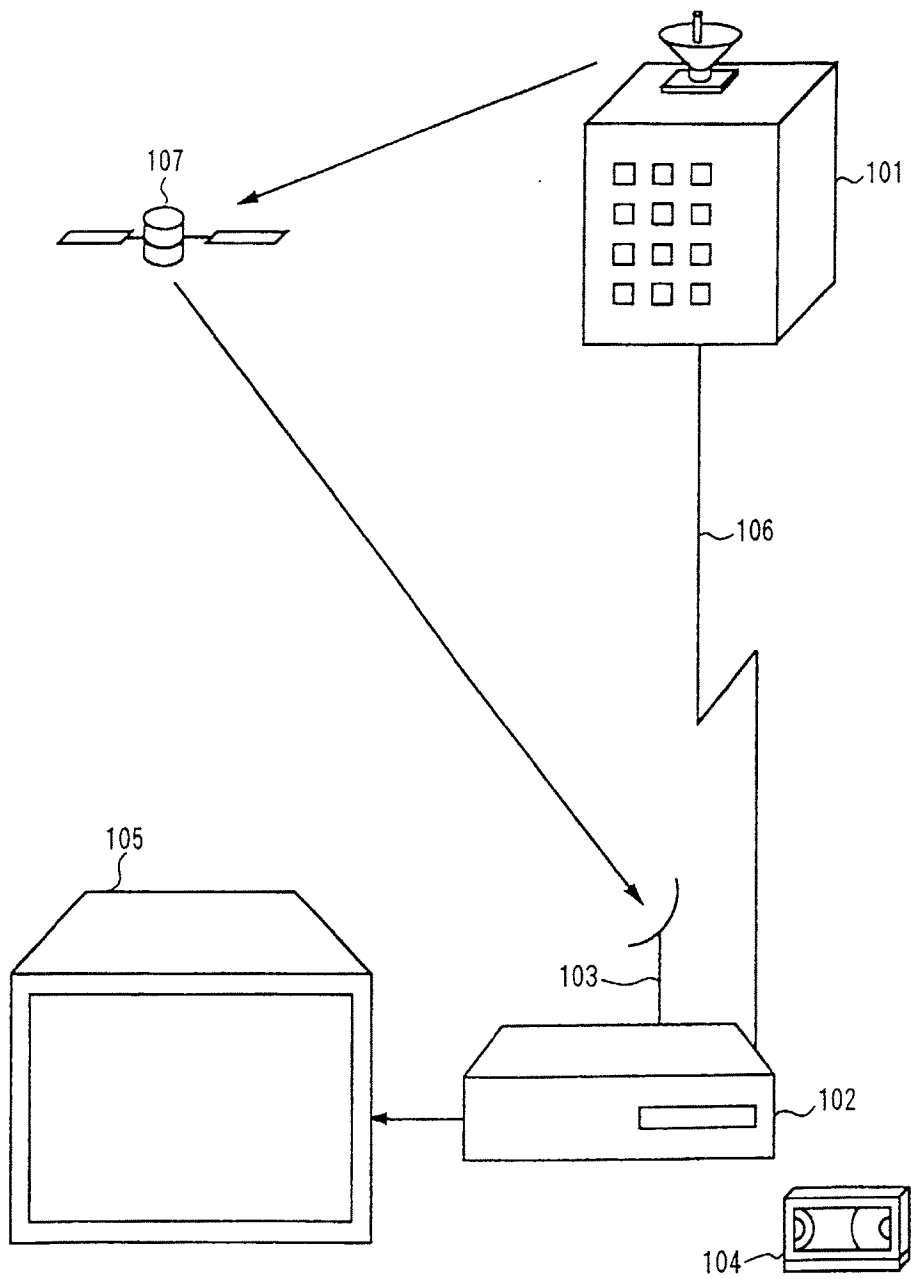


Fig. 2

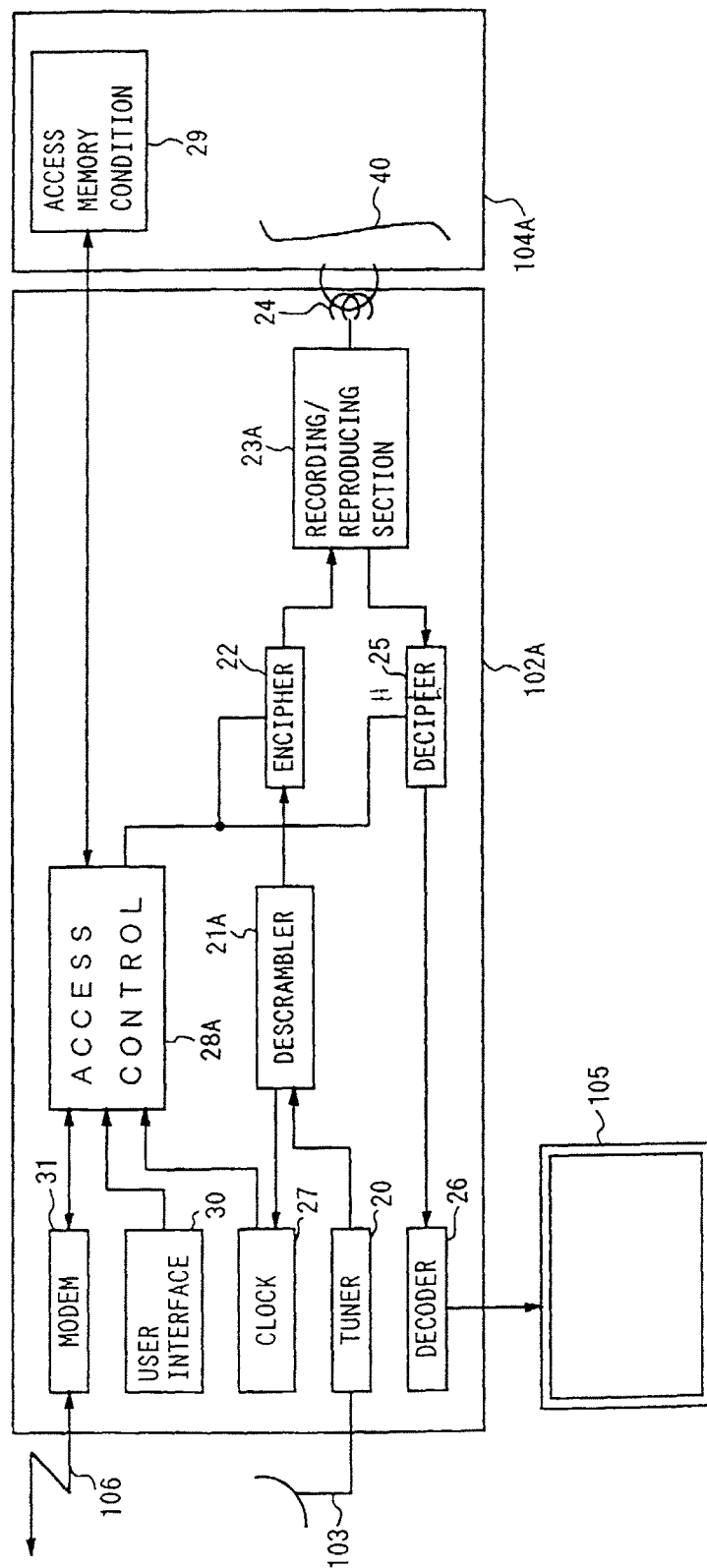


Fig. 3

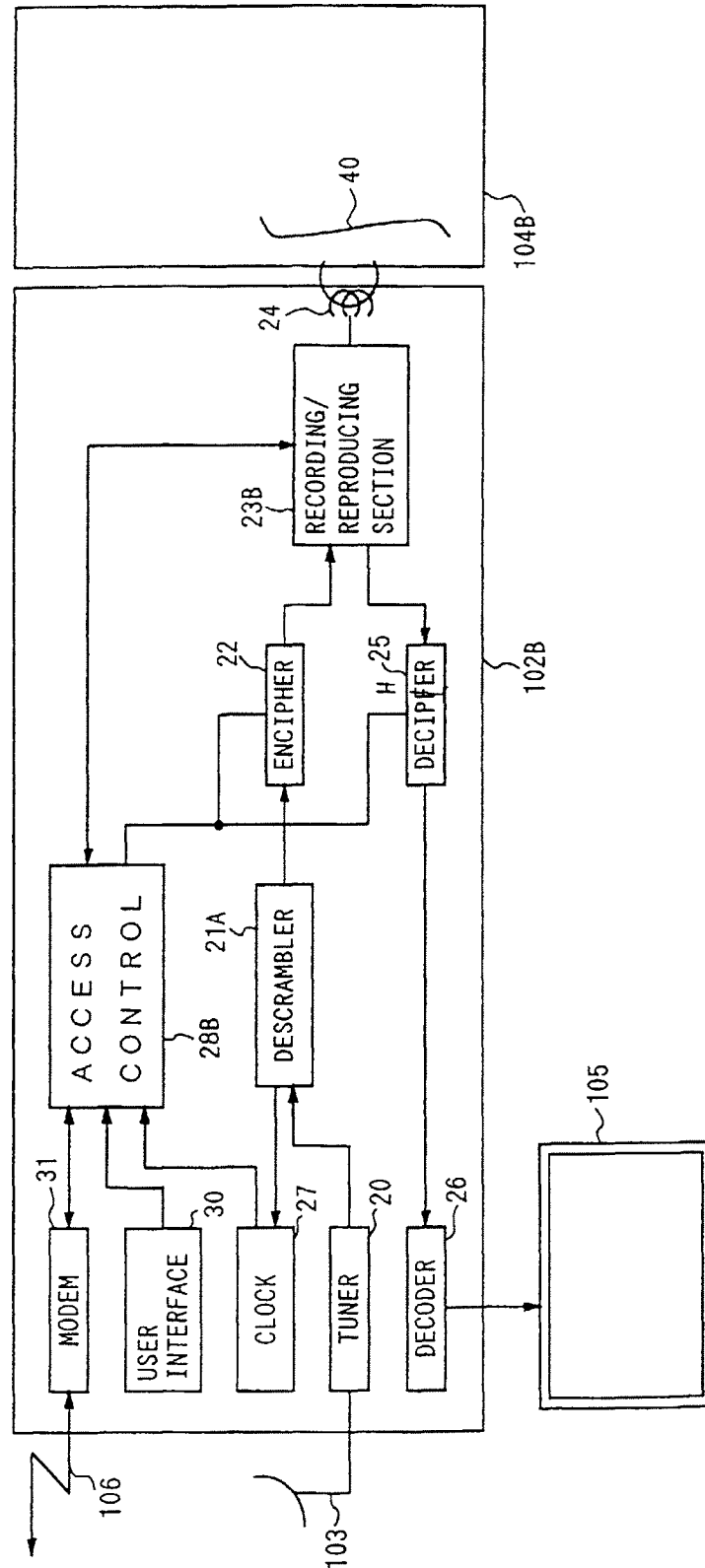


Fig. 4

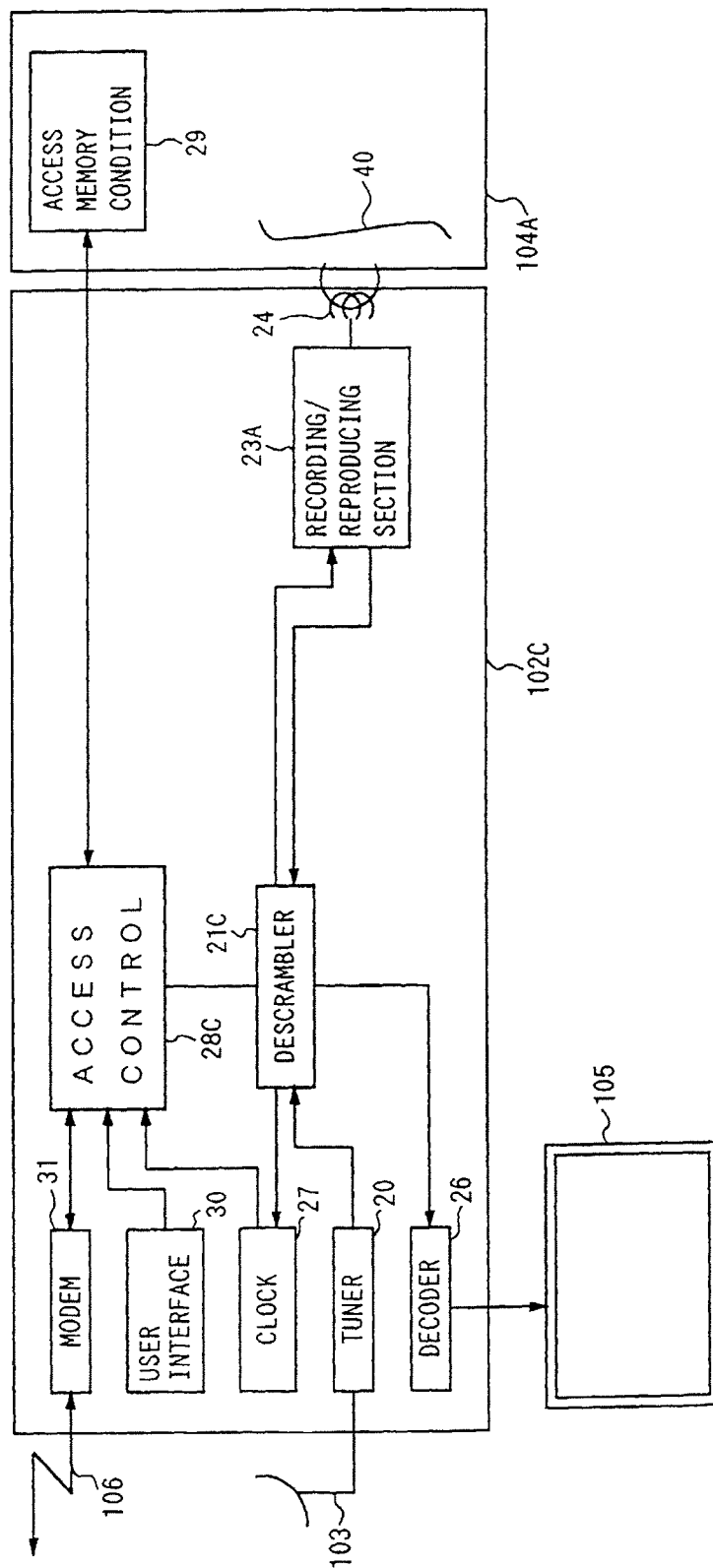


Fig. 5

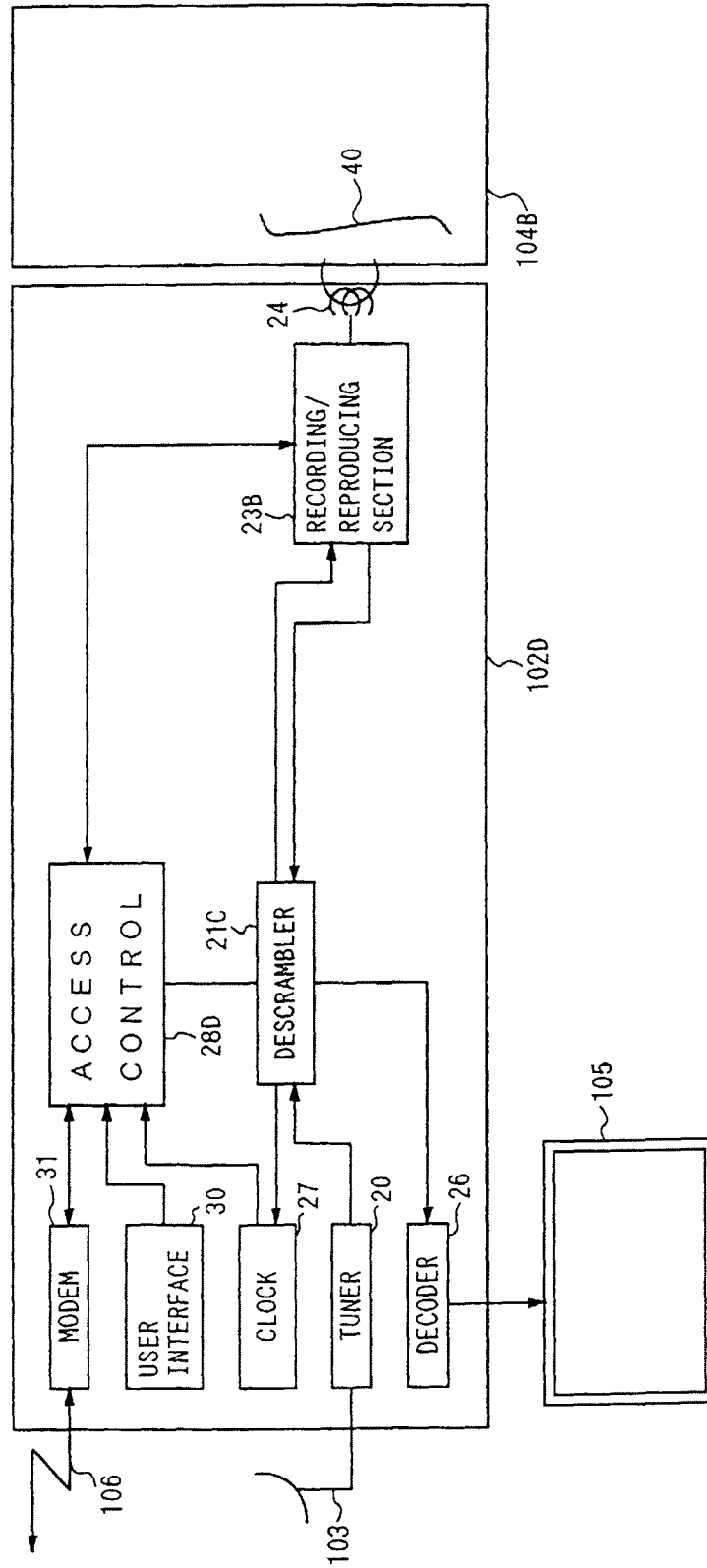


Fig. 6

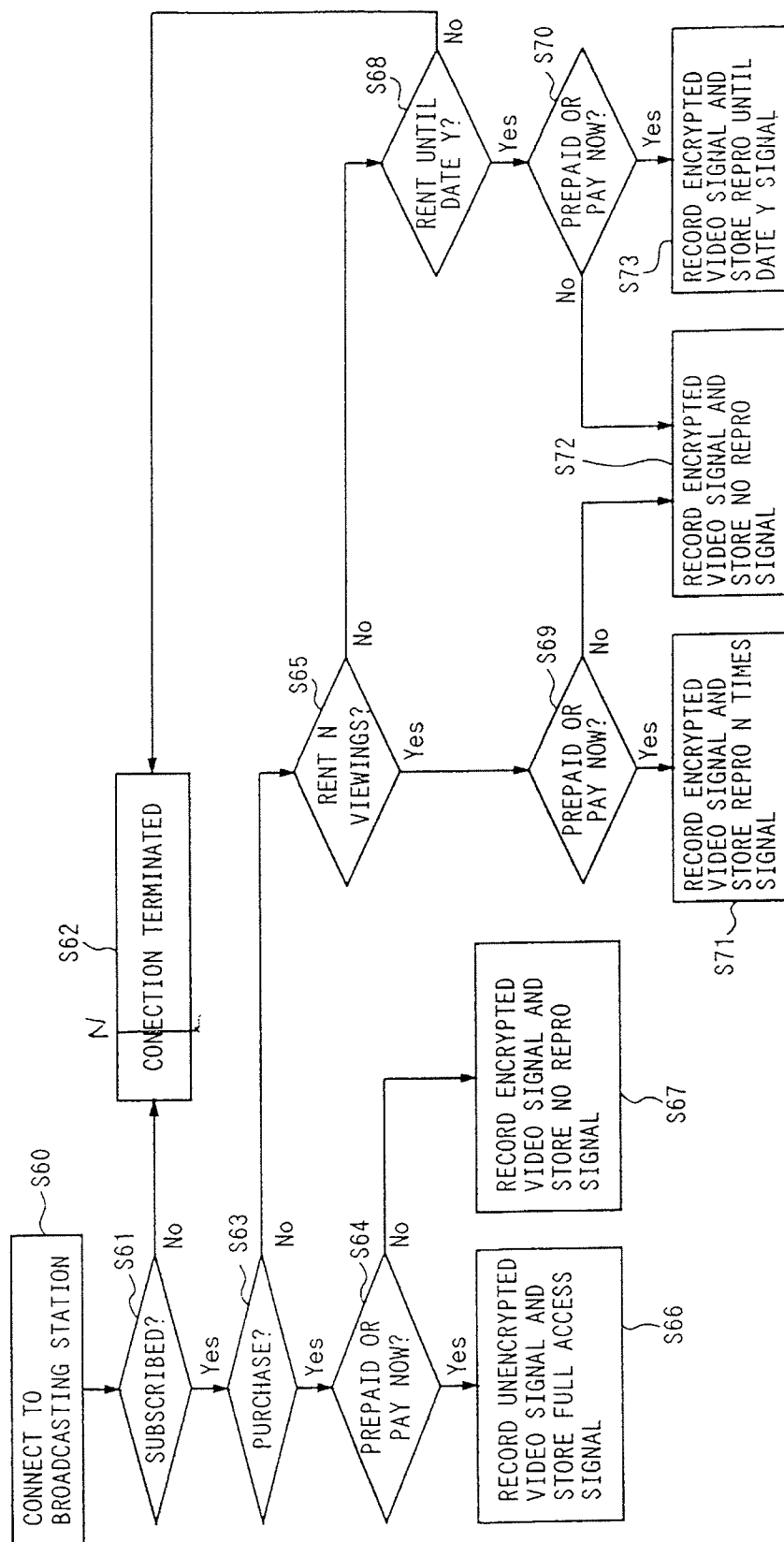


Fig. 7A

Fig. 7

Fig. 7A Fig. 7B

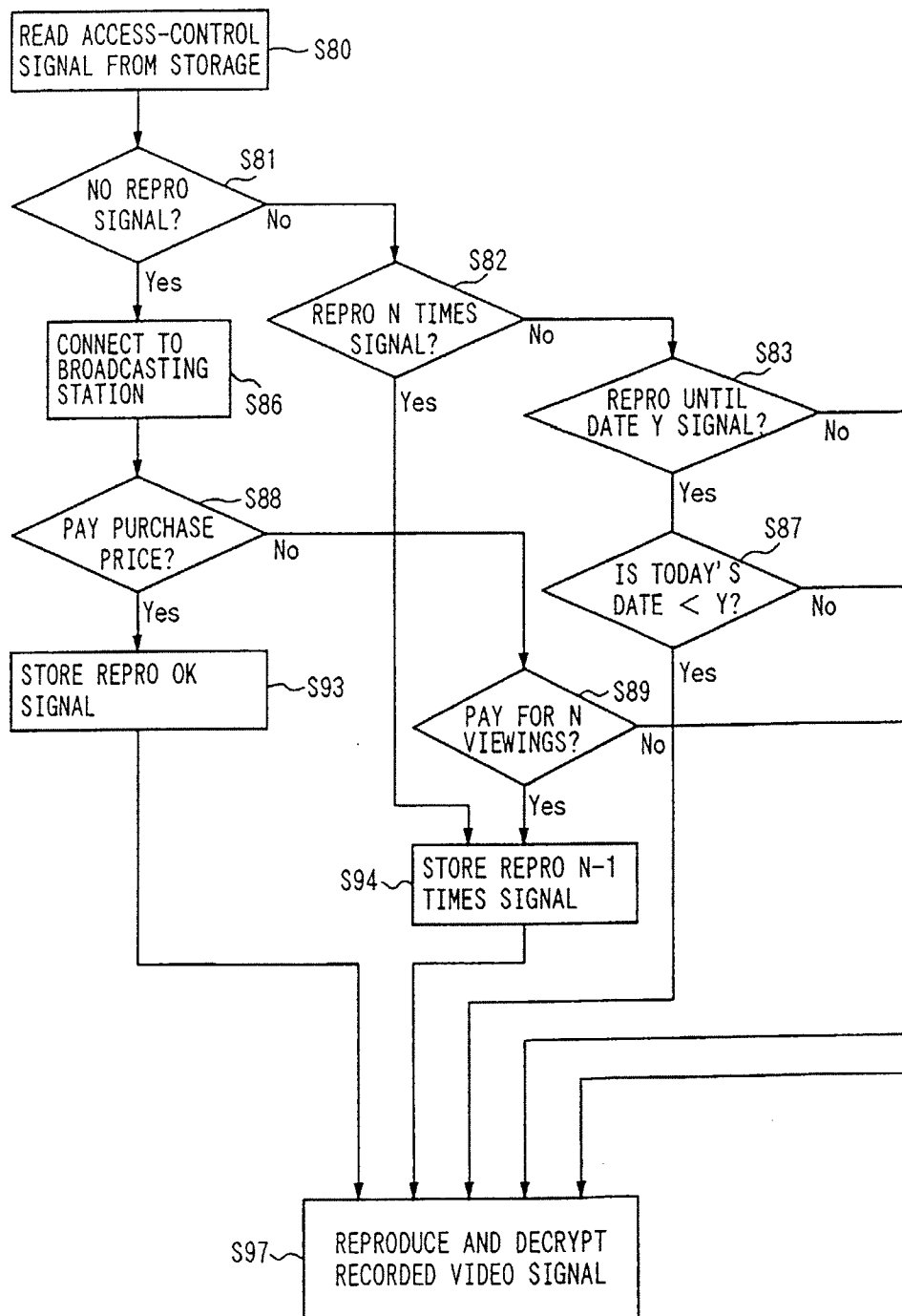


Fig. 7B

